Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem AY: Odd Sem 2019-20 | **Date**: 27.09.2019

Course Code: MEC 313 | **Time**: 2.30PM to 3.30PM

Course Name: ROBOTICS | **Max Marks**: 40

Program & Sem: B.Tech (MEC) & V DE | **Weightage**: 20%

Instructions:

(i) Draw the graphical/sketches using Pencils

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries two marks. (5Qx2M=10M)

1. A Robot is defined as---- (C.O.NO.1)[Knowledge]

   a. Re-programmable b. Multi-functional manipulator

   c. (a) & (b) d. None of the above

2. The proprioceptive sensors used for measuring .....of the end effector. (C.O.NO.2)[Knowledge]

   a. Position b. Force

   c.Velocity & acceleration d. Position, Velocity & acceleration

3. Indicate the robot part with function (C.O.NO.2)[Knowledge]

   a. Manipulator arms : 1.for holding piece or tool

   b. Controllers : 2.Move the manipulator arm and end effectors

   c. Drivers : 3.No of degrees of Movement

   d. Gripper : 4.Delivers command to the actuator

4. Predict the odd one (C.O.NO.2)[Application]

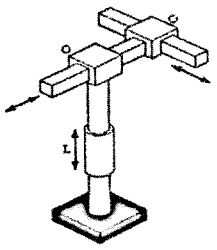
a. Cartesian co-ordinate : LOO
b. Polar co-ordinate : TRO
c. Jointed arm co-ordinate : TRR
d. Cylindrical co-ordinate : TLO

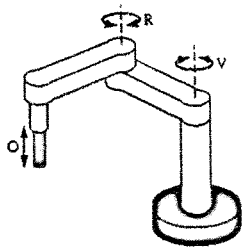
5. Distinguish Transducer and sensor. (C.O.NO.2)[Comprehension]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries ten marks. (2Qx10M=20M)

6. Discover and describe the following robot configurations (C.O.NO.1) [Application]





7. (i). Summarize the robot sensing system with human beings

(ii). Distinguish the attributes of Analog and digital sensors.

(C.O.NO.2)[Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carries ten marks. (1Qx10M=10M)

8. A KUKA Robot requires
   a. Linear motion
   b. Twisting
   c. Rotation
   d. Revolve for different applications.

Sketch and relate the joint depends on the required motion. (C.O.NO.1)[Application]

SCHOOL OF ENGINEERING

Semester: 05

Course Code: MEC 313

Course Name: Robotics

Date 27.09.2019

Time: 2.30pm-3.30pm

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1	CO1	Unit I	L			2
2	CO2	Unit II	M			2
3	CO1	Unit I		M		2
4	CO1	Unit I			L	2
5	CO2	Unit II		M		2
6	CO1	Unit I			M	10
7	CO2	Unit II		M		10
8	CO1	Unit I			M	10
9	CO2	Unit II			M	10
	Total Marks					50

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. Mr Manikanda Prabhu]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Date: 27.09.2019

Semester: 05

Time: 2.30pm – 3.30pm

Course Code: MEC 313

Max Marks: 40

Course Name: Robotics

Weightage: 20%

Part A (5 x 2 = 10Marks)

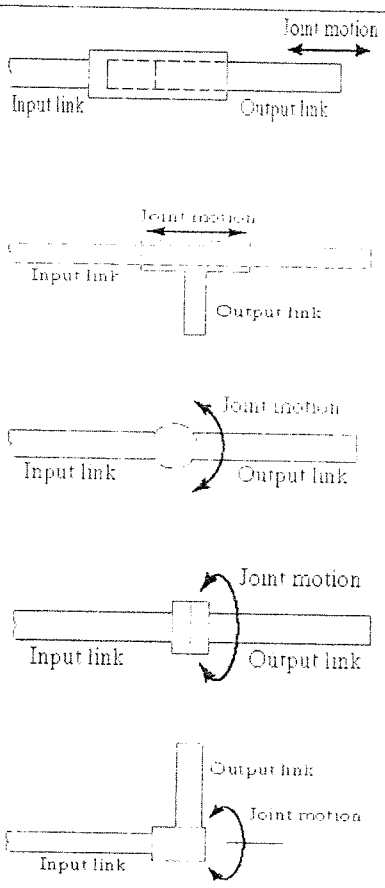
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Option c	For option, c = 2Marks For option, a or b = 1mark	1 min
2	Option d	For option, d = 2Marks For option, a or c = 1 Mark	1 min
3	a-3 b-4 c-2 d-1	If all correct, 2 Marks If any two correct, 1 Mark	2 min
4	Option b	If correct, 2 Marks	1 min
5	Sensor is a kind of transducer, But transducer is not a sensor	If correct, 2 marks Any related write up, 1 Mark	2 min

Part B (2 x 10= 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

6		Discovering the name: 2 Marks Sketching:2 Marks Description: 6 Marks (Construction, joint notations, work volume to be discussed)	10 Mins
7		(i) Comparison of robot sensor with human sensing system (Eyes, Nose, Tongue, Ear, Skin etc) If 5 Points discussed: 5marks If any related write up: 2Marks (ii) 5 attributes comparison (Accuracy level, response time, output form etc..) If 5 points discussed: 5 Marks If any related write up: 2Marks	10 Mins

Part C (Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
8		Sketching any 4 diagram: 5 Marks Description about movements (for each sketch): 5 Marks If less : 1 Mark for each sketch & Diagram	15 mins
9	Any two of following with neat sketch Ultrasonic sensor	5 Mark each 2 marks for sketching	12 mins

	Infra-red sensor Eddy current sensor Optical proximity sensor	3 marks for description (Working principle, Range)

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20
Course Code: MEC 313
Course Name: ROBOTICS
Program & Sem: B.Tech (MEC) & V

Date: 16.11.2019
Time: 2.30 PM to 3.30 PM
Max Marks: 40
Weightage: 20%

Instructions:

(i) Draw the graphical/sketches using Pencils

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries two marks. (5Qx2M=10M)

1. Ultra-sonic sensor can measure the distance from……to ……
   (C.O.NO.2) [Knowledge]
2. Distinguish touch and force sensor in robotics
   (C.O.NO.2) [Comprehension]
3. Define robotic actuators.
   (C.O.NO.3) [Knowledge]
4. Indicate the suitable components.
   (C.O.NO.3) [Comprehension]

   i. Hydraulic actuation : a. Compressor
   ii. Mechanical actuation : b. Pump
   iii. Pneumatic actuation : c. Stepper motor
   iv. Electric actuation : d. Linkages
5. Name the languages used in explicit programming method.
   (C.O.NO.3) [Comprehension]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries ten marks. (2Qx10M=20M)

6. Discuss on Image processing and analysis using vision sensors.

(C.O.NO.2) [Comprehension]

7. Compare pneumatic, hydraulic, electric actuation systems

(C.O.NO.3) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carries ten marks. (1Qx10M=10M)

8. Explain the Robot programming languages with examples.

(C.O.NO.3) [Comprehension]

SCHOOL OF ENGINEERING

Semester: 05
Course Code: MEC 313
Course Name: Robotics

Date: 16.11.2019
Time: 2.30pm-3.30pm
Max Marks: 40
Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	CO2	Unit II	2									2
2	CO2	Unit II				2						2
3	CO3	Unit III	2									2
4	CO3	Unit III					2					2
5	CO3	Unit III				2						2
6	CO2	Unit II					10					10
7	CO3	Unit III				10						10
8	CO3	Unit III					10					10
	Total Marks											40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Date: 27.09.2019

Time: 2.30pm – 3.30pm

Max Marks: 40

Weightage: 20%

Semester: 05

Course Code: MEC 313

Course Name: Robotics

Part A (5 x 2 = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	0-2.5m	2 Marks	1 min
2	Touch sensor, senses whether the object is grasped by gripper or not. Force sensor, senses how much force used to gripper to grasp the object	2 Marks	2 min
3	Devices used to actuate the robot motions	2 Marks	2 min
4	i-b, ii-d iii-a, iv-c	2 Marks	1 min
5	VAL, VAL II, AML, KAREL	2 marks	2 min

Part B (2 x 10= 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	Need to write about, 1. Sensing of image 2. Digitizing image 3. Date reduction/Edge detection 4. Interpretation of Image	Each sub topic with required information carries 2.5 Marks	10 Mins

7	Differentiate based on, 1. Source 2. Peak pressure 3.Weight of system 4. Control 5. Speed 6. Reliability 7. Main component 8. Operating cost 9. Valve operation 10. Accuracy 11. Accidental issues 12. Efficiency	Each carries one mark, At least 10 has to be correct to score full marks	10 Mins

Part C (1 x 10 = Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
8	Need to write about 1. Manual method 2. Lead through method 3. Walk through method 4. Offline programming	Each sub topic carries 2.5 marks, has to elaborate the concept of respective method	15 mins

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SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: MEC 313
Course Name: ROBOTICS
Program & Sem: B.Tech (MEC) & 5 (DE-II)

Date: 23 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Instructions:
(i) Read the all questions carefully and answer accordingly.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks. **(5Qx2M=10M)**

1. Draw a neat sketch of anatomy of Robot. (C.O.No.1) [Knowledge]
2. Compare human and robot sensing with any 4 points. (C.O.No.2) [Knowledge]
3. Define a) Proprioceptive sensor b) Exteroceptive sensor (C.O.No.2) [Knowledge]
4. Mention any 4 disadvantages of Electrical Actuators. (C.O.No.3) [Knowledge]
5. What are the advantages of legged type robot? (C.O.No.4)[Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks **(4Qx10M=40M)**

6. Explain various programming methods used in Robots. (C.O.No.3) [Knowledge]
7. What are the technical considerations required during designing of Arc welding robots. (C.O.No.3) [Comprehension]
8. Draw a neat sketch of basic components of Hydraulic system and mention its functions. (C.O.No.3)[Knowledge]
9. Name the major hardware components required for obstacle avoidance robots using Arduino and mention its functions. (C.O.No.4)[Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 15 marks. **(2Qx15M=30M)**

10. Explain with neat sketch working of Cartesian type Robot. (C.O.No.1) [Comprehension]
11. With the neat sketch explain measurement of speed of a shaft using optical encoder system. (C.O.No.2) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	C,A	
1,2,3, 4,5	CO1,2, 3,4	UNIT 1,2,3,4	10 (2+2+2+2+2)			10
6	CO3	UNIT3	10			10
7	CO3	UNIT3		10		10
8	CO3	UNIT3	10			10
9	CO3	UNIT3		10		10
10	CO4	UNIT4			15(C)	15
11	CO1	UNIT1			15(C)	15
12	CO2	UNIT2				
	Total Marks		30	20	30	80

K =Knowledge Level C = Comprehension Level, A = Application Level

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I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

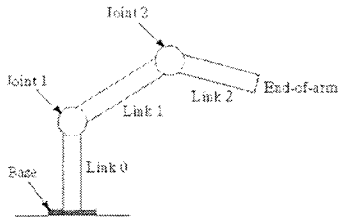
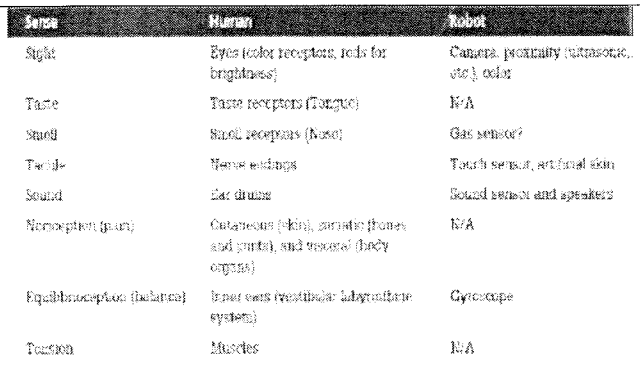
SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Semester: 2019 - 20
Course Code: MEC 313
Course Name: ROBOTICS
Program & Sem: B.Tech (MEC) & 5 (DE-II)

Date: 23 Dec 2019
Time: 9:30 AM -12:30 PM
Max Marks: 80
Weightage: 40%

Part A (5Q x 2M = 10Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1		Sketch - 2mark	5Min
2		Each difference carries 0.5 mark	5Min
3	Proprioceptive sensors measure values internally to the system (robot), e.g. battery level, wheel position, joint angle, etc. These **sensors** can be encoders, potentiometers, gyroscopes, compasses,etc. Exteroceptive sensors are used for the observation of the environments, objects. Sonar sensors, IR sensitive sensors, ultrasonic distance sensors are some examples of exteroceptive sensors	Each definition carries 1 mark	5Min
4	The disadvantages of electric actuators are • Electrical equipment is more of a fire hazard than other systems unless made intrinsically safe, in which case it becomes expensive. • Electric actuators have a poor torque - speed characteristic at low speed. • Electric actuators are all basically rotary motion and complicated mechanisms are needed to convert rotation into other forms of motion. • The power to weight ratio is inferior to hydraulic motors.	Any 4 points required. Each point carries 0.5 marks	5Min

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	C, A	
1,2,3, 4,5	CO1,2, 3,4	UNIT 1,2,3,4	10 (2+2+2+2+2)			10
6	CO3	UNIT3	10			10
7	CO2	UNIT2		10		10
8	CO3	UNIT3	10			10
9	CO3	UNIT3		10		10
10	CO4	UNIT4		15	→ 15 (A)	15
11	CO1	UNIT1		15	→ 15 (C)	15
12	CO2	UNIT2				
	Total Marks		30	50		80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Vijay Kumar S.L

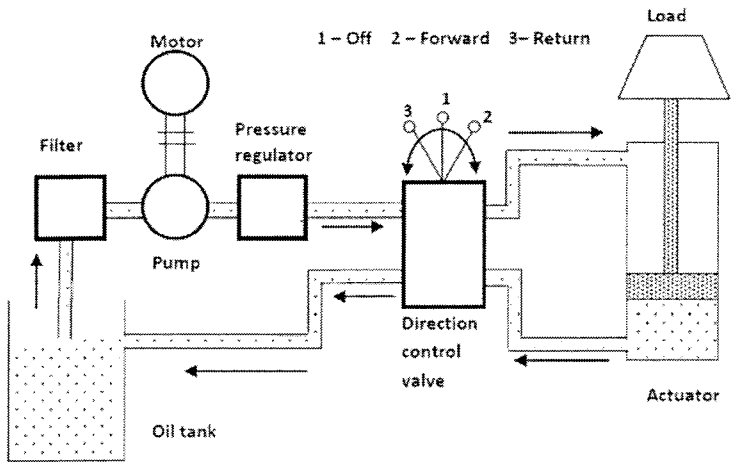
Faculty Signature:

Reviewer Commend:

5	• Less energy loss • Potentially less weight • Can traverse more rugged terrain • Legs do less damage to terrain (environmentally conscious) • Potentially more maneuverability	Any 4 points required. Each point carries 0.5 marks	**5Min**

Part B (4Q x 10M = 40 Marks)

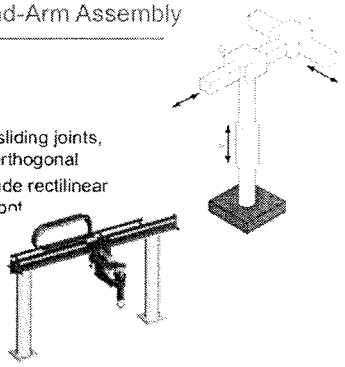
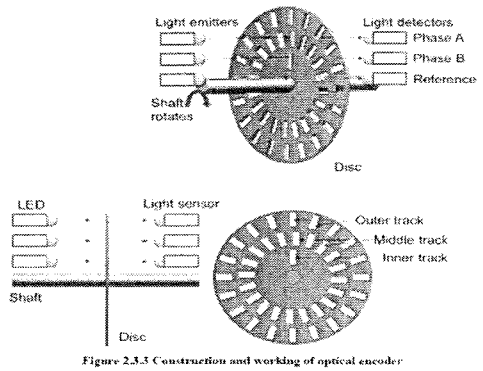
Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	programming method into four categories. 1. Manual method 2. Walkthrough method 3. Lead through method 4. Off-line programming **Manual method:** • This method is not really programming in the conventional sense of the world. It is more like setting up a machine rather than programming. It is the procedure used for the simpler robots and involves setting mechanical stops, cams, switches or relays in the robots control unit. For these low technology robots used for short work cycles (e.g., pick and place operations), the manual programming method is adequate. **Walkthrough method:** • In this method the programmer manually moves the robots arm and hand through the motion sequence of the work cycle. Each movement is recorded into memory for subsequent playback during production. The speed with which the movements are performed can usually be controlled independently so that the programmer does not have to worry about the cycletime during the walk through. The main concern is getting the position sequence correct. The walk through method would be appropriate for spray painting and arc welding. **Lead through method:** The lead through method makes use of a teach pendant to power drive the robot through its motion sequence. The teach pendant is usually a small hand held device with switches and dials to control the robots physical movements. Each motion is recorded into memory for future playback during work cycle. The lead through method is very popular among robot programming methods because of its ease and convenience. **Off- line programming:** This method involves the preparation of the robot program off-line, in a manner similar to NC part programming. Off-line robot programming is typically accomplished on a computer terminal. After the program has been prepared, it is entered in to the robot memory for use during the work cycle. The advantaged of off-line robot programming is that the production time of the robot is not lost to delay in teaching the robot a new task. Programming off-line can be done while the robot is still in production on the preceding job. This means higher	Each programming method carries 2.5 marks Any 4 programming required	20Min

	utilization of the robot and the equipment with which it operates. Another benefit associated with off-line programming is the prospect of integrating the robot into the factory CAD/CAM data base and information system.		
7	**14.2.3 Features of the Welding Robot** An industrial robot that performs arc welding must possess certain features and capabilities. Some of the technical considerations in arc-welding applications are discussed in the following: **1. Work volume and degrees of freedom** The robot's work volume must be large enough for the sizes of the parts to be welded. A sufficient allowance must be made for manipulation of the welding torch. Also, if two part holders are included in the workstation, the robot must have adequate reach to perform the motion cycle at both holders. Five or six degrees of freedom are generally required for arc-welding robots. The number is influenced by the characteristics of the welding job and the motion capabilities of the parts manipulator. If the parts manipulator has two degrees of freedom, this tends to reduce the requirement on the number of degrees of freedom possessed by the robot. **2. Motion control system** Continuous-path control is required for arc welding. The robot must be capable of a smooth continuous motion in order to maintain uniformity of the welding seam. In addition, the welding cycle requires a dwell at the beginning of the movement in order to establish the welding puddle, and a dwell at the end of the movement to terminate the weld. **3. Precision of motion** The accuracy and repeatability of the robot determines to a large extent the quality of the welding job. The precision requirements of welding jobs vary according to size and industry practice, and these requirements should be defined by each individual user before selecting the most appropriate robot. **4. Interface with other systems** The robot must be provided with sufficient input/output and control capabilities to work with the other equipment in the cell. These other pieces of equipment are the welding unit and the parts positioners. The cell controller must coordinate the speed and path of the robot with the operation of the parts manipulator and the welding parameters such as wire feed rate and power level. **5. Programming** Programming the robot for continuous arc welding must be considered carefully. To facilitate the input of the program for welding paths with irregular shapes, it is convenient to use the walkthrough method in which the robot wrist is physically moved through its motion path. For straight welding paths, the robot should possess the capability for linear interpolation between two points in space. This permits the programmer to define the beginning and end points of the path and the robot is capable of computing the straight line trajectory between the points.	Any 5 technical consideration required. Each point carries 2 mark	25Min
8	 **1. The hydraulic actuator is a device used to convert the fluid power into mechanical power to do useful work. The actuator may be of the linear type (e.g., hydraulic cylinder) or rotary type(e.g., hydraulic motor) to provide linear or rotary motion, respectively.**	Sketch carries -5 Mark Explanation-5mark	25Min

	2. The hydraulic pump is used to force the fluid from the reservoir to rest of the hydraulic circuit by converting mechanical energy into hydraulic energy. **3. Valves are used to control the direction, pressure and flow rate of a fluid flowing through the circuit** **4. External power supply (motor) is required to drive the pump.** **5. Reservoir is used to hold the hydraulic liquid, usually hydraulic oil.** **6. Piping system carries the hydraulic oil from one place to another.** **7. Filters are used to remove any foreign particles so as keep the fluid system clean and efficient, as well as avoid damage to the actuator and valves.** **8. Pressure regulator regulates (i.e., maintains) the required level of pressure in the hydraulic fluid.**		
9	Hardware Required • Arduino Uno • Ultrasonic Range Finder Sensor – HC – SR04 • Motor Driver IC – L293D • Servo Motor (Tower Pro SG90) • Geared Motors x 2 • Robot Chassis • Power Supply • Battery Connector • Battery Holder • **Arduino Uno** Arduino Uno is an ATmega 328p Microcontroller based prototyping board. It is an open source electronic prototyping platform that can be used with various sensors and actuators. Arduino Uno has 14 digital I/O pins out of which 6 pins are used in this project **HC – SR04** • It is an Ultrasonic Range Finder Sensor. It is a non-contact based distance measurement system and can measure distance of 2cm to 4m. **L293D** • It is a motor driver which can provide bi-directional drive current for two motors. **Servo Motor** • The Tower Pro SG90 is a simple Servo Motor which can rotate 90 degrees in each direction (approximately 180 degrees in total). **Working** • Before going to working of the programme, it is important to understand how the ultrasonic sensor works. The basic principle behind the working of ultrasonic sensor is as follows: • Using an external trigger signal, the Trig pin on ultrasonic sensor is made logic high for at least 10µs. A sonic burst from the transmitter module is sent. This consists of 8 pulses of 40KHz. • The signals return back after hitting a surface and the receiver detects this signal. The Echo pin is high from the time of sending the signal and receiving it. This time can be converted to distance using appropriate calculations.	Mentioning all Hardware components- 5Mark Explanation of any 5 components – 5 marks	25Min

	• The aim of this project is to implement an obstacle avoiding robot using ultrasonic sensor and Arduino. All the connections are made as per the circuit diagram. The working of the project is explained below.		

Part C (2Q x 15M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
10	 Cartesian Coordinate Body-and-Arm Assembly * Notation LOO: * Consists of three sliding joints, two of which are orthogonal * Other names include rectilinear robot and x-y-z robot  Applications • Most assembly operations • Handling at machine tools • Application of sealant • Pick and place • Arc welding	Sketch-10mark Explanation-5 mark	30Min
11	OPICAL ENCODERS  Figure 2.3.3 Construction and working of optical encoder • Optical encoders provide digital output as a result of linear / angular displacement. These are widely used in the Servo motors to measure the rotation of shafts. • Figure shows the construction of an optical encoder. It comprises of a disc with three concentric tracks of equally spaced holes. Three light sensors are employed to detect the light passing thru the holes. • These sensors produce electric pulses which give the angular displacement of the mechanical element e.g. shaft on which the Optical encoder	Sketch-8mark Explanation-7 mark	30Min

	is mounted. The inner track has just one hole which is used locate the 'home' position of the disc. • The resolution can be determined by the number of holes on disc. With 100 holes in one revolution, the resolution would be, $360^{o}/100 = 3.6^{o}$.		